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TAGGING EXPERIMENT RESULTS ON COD IN WESTERN NORWAY FJORD AREAS
by

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ABSTRACT

During recent years, experiments with large scale release of artificially produced 0-group cod at locations in western Norway waters have been carried out with the aim of increaseing the cod catches. As the general knowledge of the cod biology in the release areas is rather poor, the effect of these releases on the cod stock size is still a matter of discussion.

In 1981 and 1982 tagging of "wild" cod was carried out in two areas comparable to the experimental locations for artificially produced cod. In this paper migration and fishing pressure is discussed on the basis of recapture results from these tagging experiments. A preliminary comparison of results from the experiments on released artificially produced cod is made.

The results indicate very limited migration away from the tagging seats; less than 30 n.miles. The recapture frequency was 32 and 40% in the two areas. The commercial catches of cod from the main recapture areas are insignificant and thus indicate that the population sizes are very small.

INTRODUCTION

In the period 1979-1983 a project on coastal cod off the north-western Norway coast (the Møre area) was carried out. The aim of the project was to increase the knowledge of the biology and potential production of this coastal resource. A main aim of the project was to map the migration of the coastal cod by means of tagging experiments (Godø, 1983, 1984, 1986). Information on coastal cod in adjacent areas was of interest, and therefore tagging experiments were carried out in two locations in the Bergen area in 1981 and 1982.

In the recapture period of these experiments, there was a breakthrough in the large scale production of cod fry at the Biological Station of Austevoll. One of the aims of the Austevoll project was to increase cod production in coastal water by realeasing artificial produced cod fry. Several groups of Austevoll produced cod have been released in the Bergen area since 1982 (Svåsand, 1985). The general knowledge of the cod biology in the area is, however, poor and limits the possibility of analysing the effect of the experiments.

This paper deals with the recapture results from the two sets of experiments in the Bergen area. The results are compared with results from tagging experiments from the Møre area as well as earlier tagging experiments in the Bergen area. Further a comparison with results from the first tagging/release experiments with artificially produced cod is made.

MATERIAL AND METHOD

All the cod were tagged with hydrostatic Lea tag fastened in front of the first dorsal fin (ANON, 1953). The fish were caught by trap net in 5 - 50 meters depth. The most viable fish were selected and tagged. The position of release and the number tagged is shown in Fig. 1 and 2 and Table 1. In 1981 cod were tagged at the east side of Sotra island. In the 1982 experiments tagged cod were released in the Sør fjord south of Osterøy. This is a typical threshold fjord. Both tagging/releases were done in December.

Table 1. Numbers of fish released and recaptured in the two sets of experiments.

	No. tag.	No. recap.	% recap.
Sotra 1981	100	32	32
Sørfjord 1982	159	64	40

Length measurements refer to total fish length, and the data was organized in 5-cm groups, i.e. when later referring to length group 35, all cod from length 35cm to 39cm are included.

RESULTS

Table 1 shows the numbers and percentages recaptured from the two experiments. All together 32 and 64 tags were returned by May 1986 which is 32 % and 40 % of the released cod off Sotra and in Sørfjord respectively. Fig. 3 present the length distributions of the tagged fish in the two areas, and Fig. 4 shows the percent recaptured within each 5-cm group. The tagged Sotra cod were from 25 - 49 cm, but the greater part was between 25cm and 39 cm. The Sørfjord fish varied between 30cm and 80cm, but most of the fish were of length 35 - 49 cm. No general trend in variation of recapture frequency with length was found.

In Table 2 and 3 the recaptures are distributed on recapture month and gear. The moving sum of three months' recaptures (Fig. 5) in the Sotra experiments remained rather stable during the first year, and thereafter decreased rapidly to 0 in month 22 after release. The corresponding development in the Sørfjorden experiment was a drastic reduction of the recapture frequency during the first year. The moving sum dropped to zero in month 18; recaptures were also recorded, however, from month 24 to month 29.

The geographic distributions of the recaptures by year from both experiments, are characterized by a dominant proportion of the tag recapture returned from the tagging area. A few tag recaptures showed

migration away from the tagging seat, but never more than about 30 n.m.. A spawning migration out of the Sør fjord is indicated in 1983 by four recaptures having been taken on the spawning ground Eidsvåg close to Bergen, (the area is assumed to be a spawning area as seasonal fishery on mature cod is conducted during the cod spawning period).

Tables 1 and 2 show the distribution of fish according to mode of recapture. In the Sør fjord experiments 27% of the returned tags were taken in gamefishing by angling. Probably also much of the gill net caught fish must be considered noncommercial. The official fishery statistics had no recorded landings in the Sør fjord area. According to information from local fishermen on Sotra, the fishing here as well must be considered mainly noncommercial.

DISCUSSION

The number of tagged/recaptured fish is limited in these experiments. We consider, however, the results to be consistent enough to supply valuable information about the local cod populations, which has until now been sparse.

In neither of the studied areas did the length at release appear to play an important role in recapture frequency(Fig. 4). The two experiments are considered comparable concerning migration in spite of a considerable difference in fish length at time of release. The delayed decrease of tag recapture frequency in the Sotra experiment(Fig. 5), is probably a result of smaller size at release(Fig. 3) and thus of delayed interest in terms of exploitation.

Age determination of cod in the release areas was not available. If information on age-length from other coastal areas in western Norway is valid for the investigated area(Godø, 1977, 1984, Salvanes Inst. Marine Research, Bergen, pers.com.), the tagged cod in the two areas were mainly one and two year olds in December 1981 and 1982. Maturity studies in the same investigations, also indicate that most of the cod at that age are immature/maturing. The tagging experiments are thus considered to have been performed in nursery areas of the coastal cod.

In both areas the migration away from the tagging locations is very limited. This is consistent with observations of migration of coastal cod tagged in nursery areas off Møre (Godø, 1983, 1984) as well as of artificially produced cod (Moksness and Øiestad, 1984, Svåsand, 1985). The spawning migration out of the Sør fjord is worth noticing.

In both experiments the tagged cod more or less disappeared from the catches after about two years of freedom, or possibly after maturation (Fig. 5). This may be caused by high exploitation rates or by a change in migration pattern of mature individuals, which make them less vulnerable to fishing. Godø (1986) discussed migration of cod in Norwegian waters and found that cod on nursery grounds in sheltered coastal areas are very stationary, while cod migration increases when nursery grounds become less isolated from the open sea. Høyen (1964) tagged coastal cod on spawning grounds north of Sotra. The recapture results indicated a much wider geographic distribution of the mature cod, than observed on the immatures in the present experiments. The same difference between immatures and matures is indicated for the Møre region by Godø (1984). This may support the idea of increased migration after maturation. A considerable number of the recaptures in both areas in these experiments were taken by game fishing. Recordings of commercial catches in the official fisheries statistics for the two studied areas are either not specified or are insignificant, basically because commercial fishing hardly exists. These facts together with the high recapture rates indicate very low abundance of cod in the two studied areas. The most reasonable explanation of the difference between the current results and those of Høyen (1964) is probably that migrating cod from distant nursery areas spawn in the Sotra area and subsequently move out again, rather than an extensive emigration after maturation and spawning.

In Fig. 6 results from tagging recapture experiments on artificial produced cod from 1982 are presented (Svåsand, unpub. results). The cod were released in the Austevoll area south of Sotra in September 1982. There may still be some tags returned from this release, but as the diagram indicates, the fish more or less disappeared from the catches at an age of about 48 months (four years). Assuming that the

Sotra and Sørfjord cod were mainly one and two year olds respectively (based on age-length relationship) in December of the tagging years, the ages at release for the two groups were 21 and 33 months. In Fig. 6 the ages at release, and the ages when number of tags per month approaches zero, are indicated for the tagged "wild" cod, together with the recapture results of the Austevoll cod. The results so far indicate that few fish from any of the three groups are four years or more when recaptured.

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Table 2. Recapture results in the Sør fjord experiments. Number of reported recaptures distributed on year and month of recapture.

Month-year	Trap net	Gill net	Game angl.	Unkn- own	Total
December-82	4	1			5
January-83	4	1	3	2	10
February-83	2	6			8
March-83		2	3		5
April-83	1	2	3	1	7
May-83	1	4	4	1	10
June-83			2		2
July-83	2	1			3
August-83	1		1		2
Septemb.-83	2	1			3
November-83		1			1
Februar-84		1			1
August-84		1			1
November-84	3				3
February-85	1				1
March-85		1			1
April-85				1	1
Total	21	22	16	5	64

Table 3. Recapture results in the Sotra experiments. Number of reported recaptures distributed on year and month of recapture.

Tid	Trap net	Gill net	Game angl.	Unkn- own	Total
December-81		1		2	2
February-82		2	2		4
March-82		1		1	2
April-82				1	1
May-82		3			3
June-82		2	1		3
July-82				1	1
August-82	1				1
Septemb.-82		2			2
October-82		3			3
November-82		1			1
December-82		2			2
February-83		1			1
March-83		1			1
June-84		1			1
Total	1	20	3	5	29

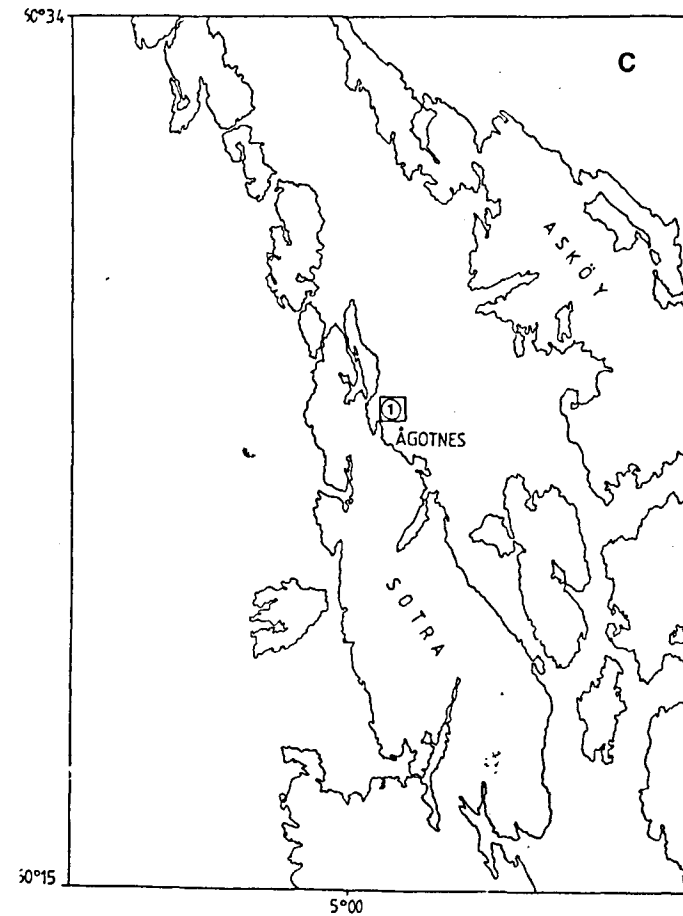
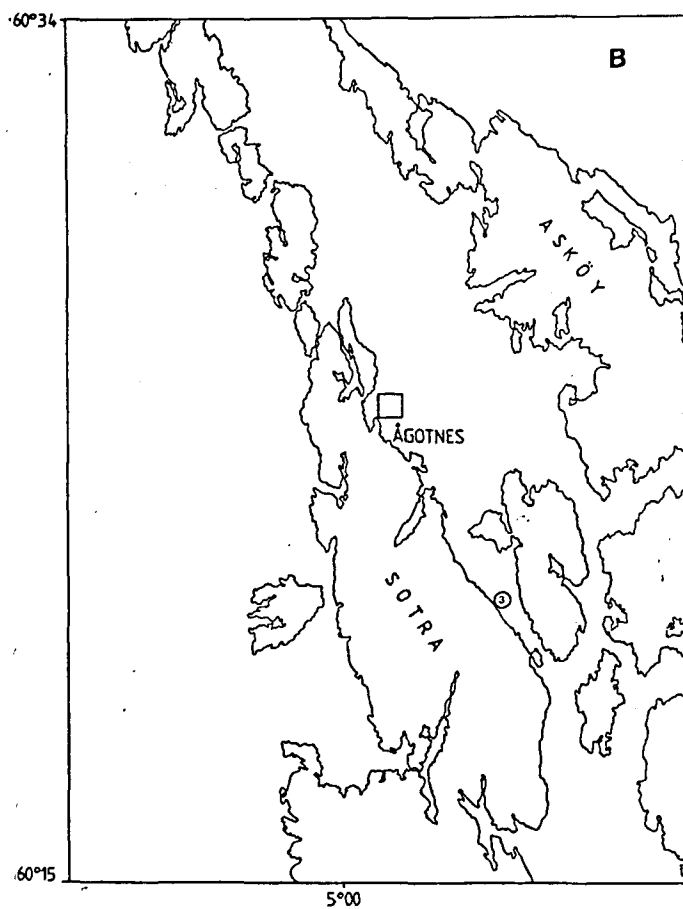
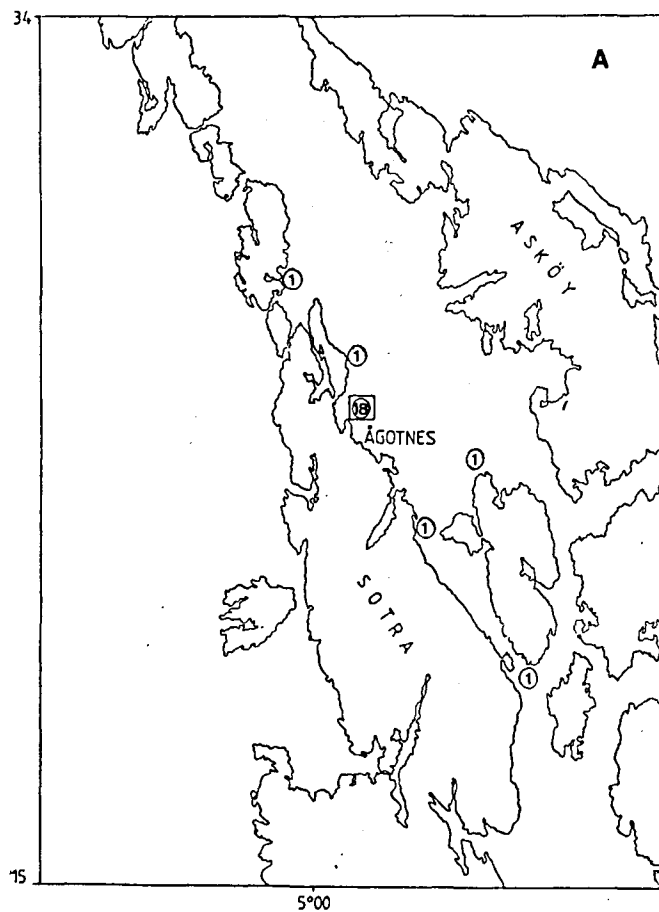


Fig. 1. The Sotra area with tagging site (square) and recapture locations indicated. Encircled figures give the number of recaptures at different locations. Recaptures are given for A) December 1981 and 1982, B) 1983, C) 1984.

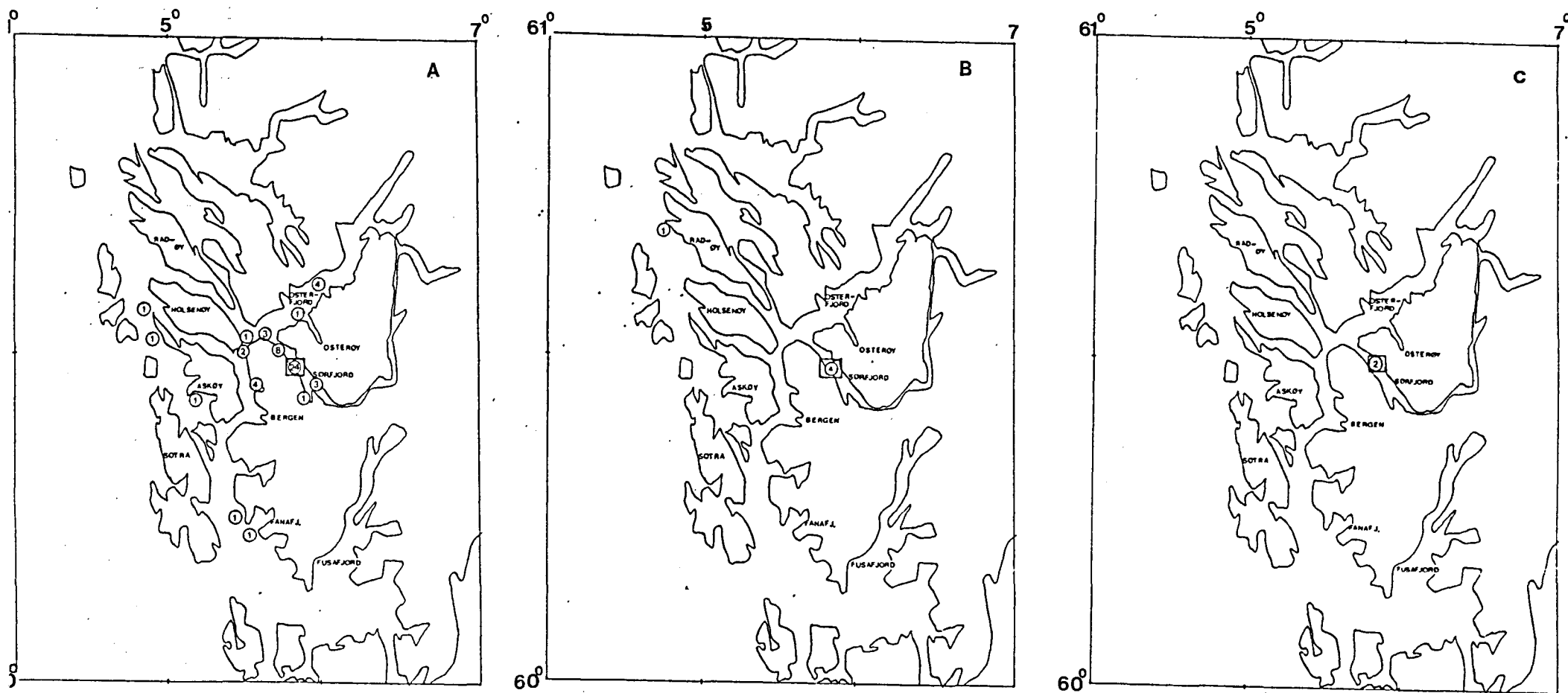


Fig. 2. The Sør fjord area with tagging site (square) and recapture locations indicated. Encircled figures give the number of recaptures on different locations. Recaptures are given for A) December 1982 and 1983, B) 1984, C) 1985.

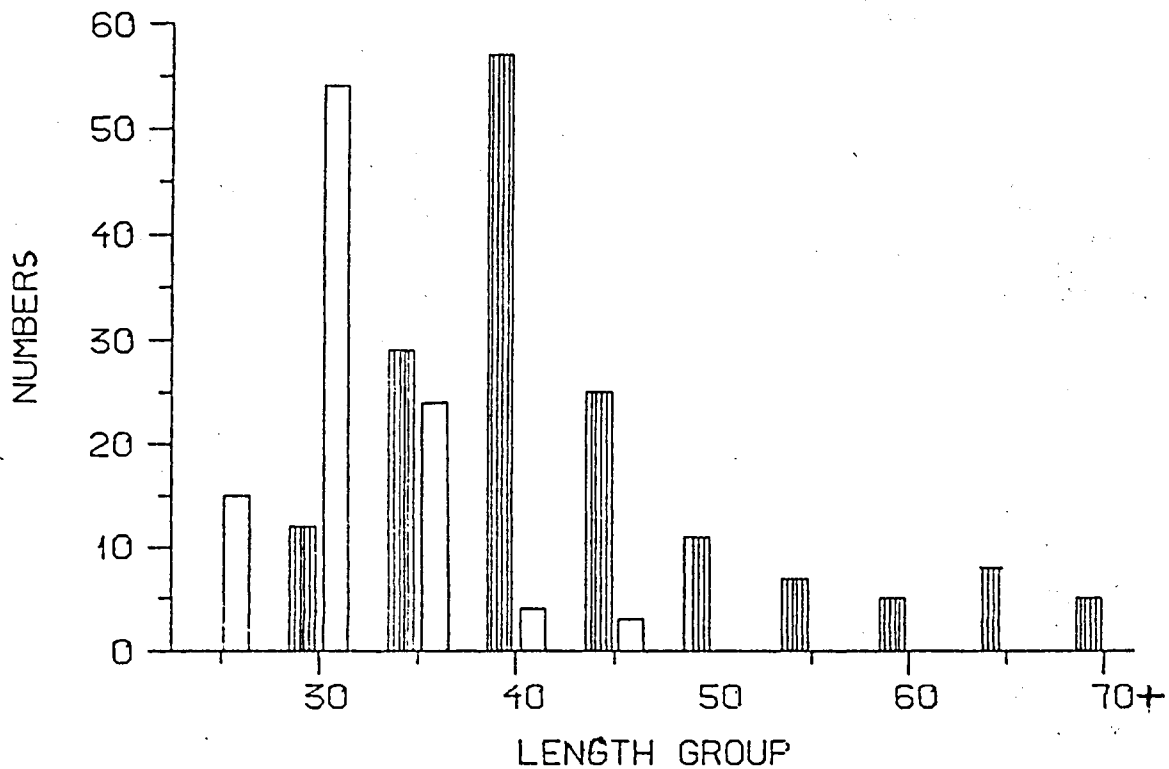


Fig. 3. Length distributions of the tagged fish in the two areas; open columns Sotra, hatched columns Sør fjord.

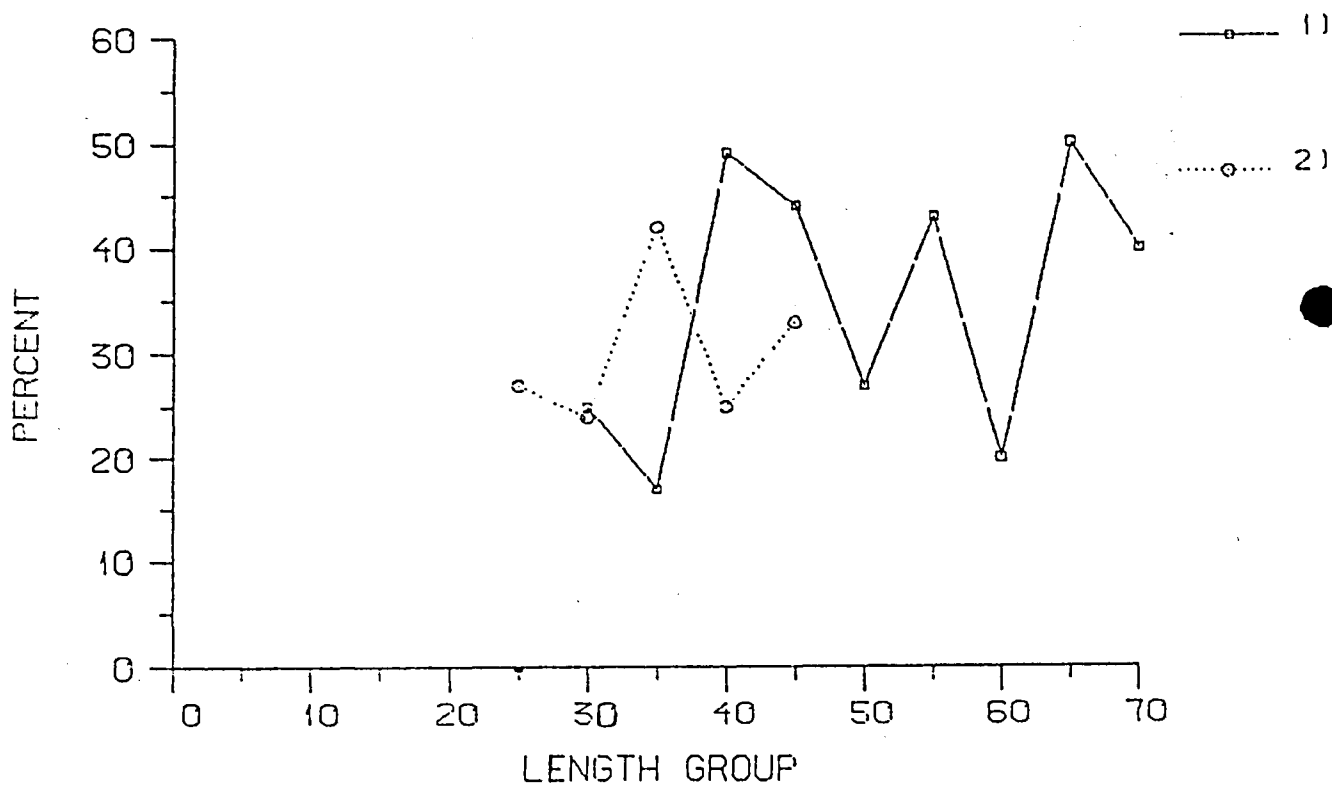


Fig. 4. The percent recaptured within each 5-cm group of the Sør fjord(1) and the Sotra(2) tagging experiments.

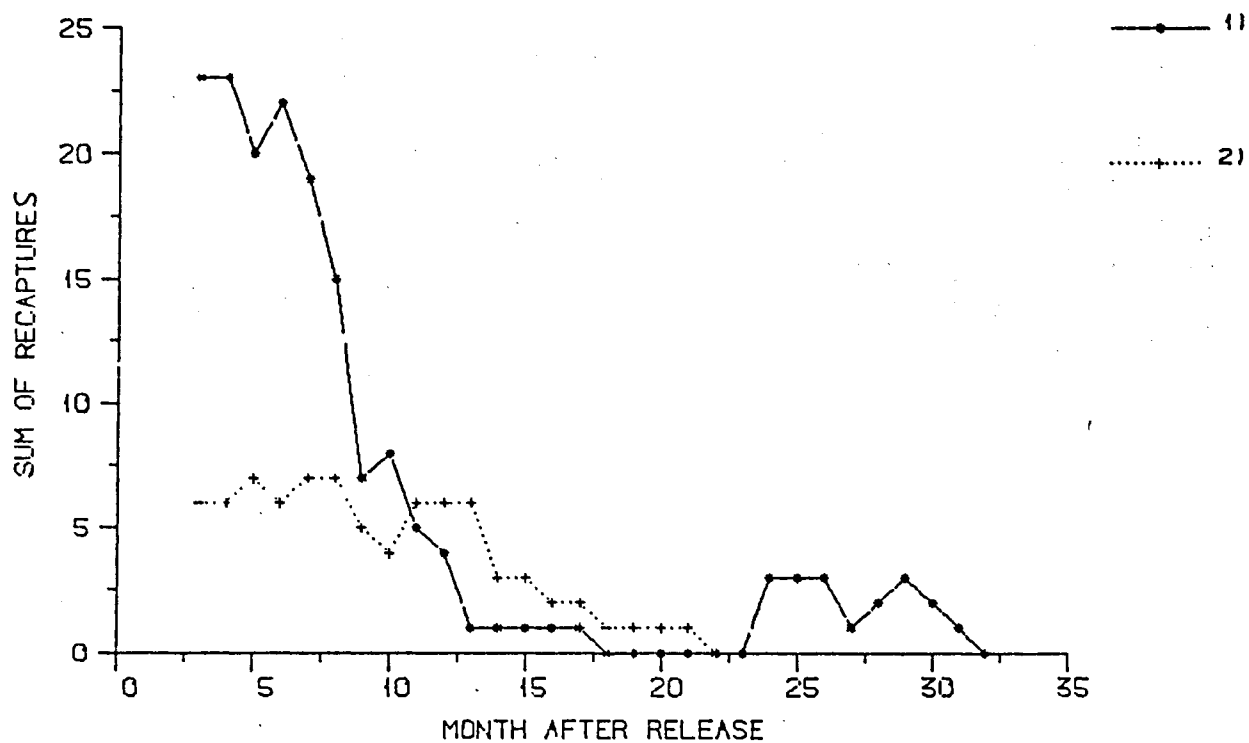


Fig. 5. The moving sum of three months recaptures in the Sør fjord(1) and the Sotra(2) experiments.

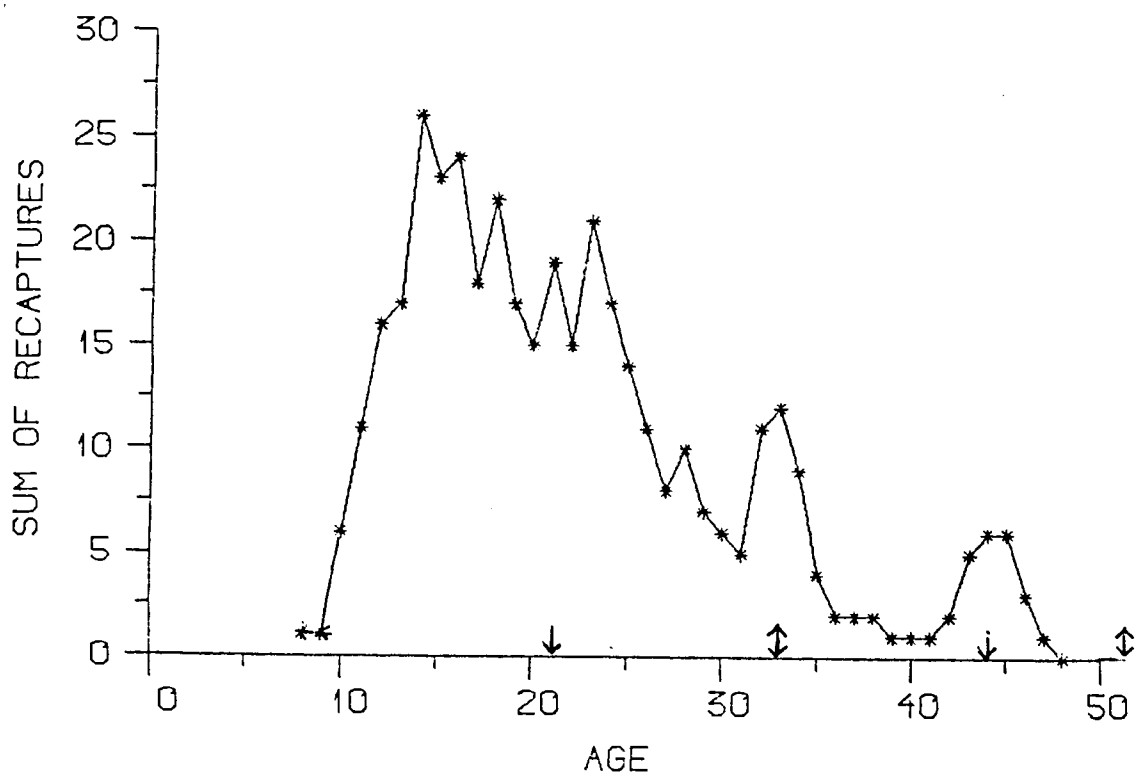


Fig. 6. The moving sum of three months recaptures in the 1982 Austevoll experiments against age (months). The ages at release and the ages on approaching zero recaptures per month for the "wild" cod, Sotra experiments(↓) and Sør fjord experiments(↕), is indicated.